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Description

This invention relates to a rotary sprinkler, and in particular to a rotary sprinkler of the kind having a rotatably mounted outlet nozzle arranged to be rotated by a water driven ball-impact type motor (see document US-A-2 990 120).

Rotary sprinklers having water driven ball-impact type drive motors have long been known. With such sprinklers, a drive ball is located within a drive motor enclosure, itself fixedly located within a sprinkler housing, and upon the inflow of water through tangentially directed opening formed in the motor enclosure, the drive ball is rotatably displaced within the housing and, during its rotational displacement, successively impacts an impeller element formed integrally with the rotatable outlet nozzle, thereby causing rotation of the nozzle. An example of a rotary sprinkler having such a ball-impact type drive motor is disclosed, for example, in U.S. patent specification Serial No. 2,052,673 (Stanton). In this known type of rotary sprinkler, the motor enclosure has a relatively limited axial dimension and the rotary displacement of the drive ball is within a uniquely defined ball race into which the impeller element projects. In consequence, the successive impacting of the impeller element by the ball takes place at very short intervals (each interval corresponding to the time taken for the ball to perform a complete rotational movement within the ball race). In effect, therefore, and despite the fact that the impact element is intermittently struck by the ball, the intervals between successive impacts is so small that the impact element, and in consequence the nozzle, is substantially continuously rotated.

It is known that the range of spray of such rotary sprinklers wherein the outlet nozzle is substantially continuously rotated, tends to be very limited. It is therefore known to provide rotary sprinklers with an intermittent drive wherein a relatively significant time elapses between successive rotational displacements of the nozzle. One well-known form of rotary sprinkler wherein such spaced-apart intermittent displacements of the nozzle is achieved, is the impact hammer-type rotary sprinkler. A disadvantage of such impact hammer-type sprinklers resides in the fact that they are of a relatively complicated construction and are, on the one hand, relatively expensive and, on the other hand, involving as they do a significant number of moving parts, faulty operation of the sprinkler is likely requiring periodic maintenance and servicing.

In order to achieve the desired spaced-apart intermittent displacements of the rotary sprinkler using a ball-impact type drive motor, it is necessary to ensure that the time interval between successive impacting of the impeller element of the

nozzle by the ball is substantially increased. One known way of achieving such an increase in this time interval is by extending the axial extent of the motor enclosure and providing the enclosure, in addition to its base wall (in which are located one or more tangentially directed water inlets), with an outwardly tapering side wall, the impeller element being located adjacent the flared mouth of the enclosure. With a rotary sprinkler having such a drive motor (shown, for example, in U.S. patent specification serial Nos. RE 25942 and 2,990,120 (Reynolds), once the drive ball is set into rotational displacement under the influence of the tangentially directed water inflow, the ball effectively climbs the outwardly tapering wall of the enclosure in an upwardly directed rotary manner, and only when the ball has reached the upper end of the enclosure does it strike the impeller element rotating the latter and thereby imparting an instantaneous rotation to the nozzle. After striking the impeller element, the momentum of the ball is lost and the ball moves gravitationally downwards, only to be struck again by the tangentially directed water inflow and to repeat its rotational upward movement until it again strikes the impeller element. In this way, it is ensured that the successive impacting of the impeller element by the ball is significantly spaced apart in time.

With such known rotary sprinklers, however, the first impacting contact between the drive ball and the impeller element takes place when the upper tip of the drive ball contacts the impeller element. In view of the fact that contact between the drive ball and the impeller element is limited to the tip of the drive ball, there is not really an effective transfer of momentum of the drive ball to the impeller element, and the rotary displacement of the impeller element, and in consequence the rotary nozzle, may well prove to be inadequate.

It is an object of the present invention to provide a rotary sprinkler with a ball-impact drive motor in which the above-referred-to disadvantage is substantially overcome.

According to the present invention there is provided a rotary sprinkler comprising a sprinkler housing; a water inlet of said housing; an outlet nozzle of said housing rotatably mounted with respect thereto; an open ended drive motor enclosure fixedly located within said housing; a base wall of said enclosure; an axially directed side wall of said enclosure which tapers outwardly with respect to said base wall; at least one tangentially directed opening formed in said base wall and communicating with said water inlet; a drive ball of predetermined diameter (D) located in said enclosure; an impact element formed integrally with said nozzle and spaced from said base wall by a distance which is not substantially less than 2D;

characterised in that

a first major axial portion of said side wall extending from said base wall to an intermediate peripheral position thereof defines a first angle α_1 with respect to a normal to the said base wall whilst a second minor axial portion of said side wall, extending from said intermediate peripheral position to an edge rim of the enclosure, defines a second angle α_2 with respect to a normal to the base wall wherein α_2 is substantially greater than α_1 , said impact element being spaced from said intermediate peripheral position by a distance which is not substantially less than $0.5D$.

With such a sprinkler, once the rotating drive ball has been upwardly displaced until it reaches the intermediate peripheral position, the continued rotational displacement of the ball is accompanied by a relatively substantial upward displacement as the ball climbs the minor axial portion of the side wall, so that impact between the drive ball and the impeller element will take place at an intermediate position on the drive ball, thereby ensuring the effective transmission of momentum from the drive ball to the impeller element.

The outlet nozzle of said housing may have defined therein an axially directed tubular through-flow passage and an outlet passage of the nozzle communicating with the throughflow passage and formed with a curved, deflecting wall, wherein the throughflow passage communicates with the outlet chamber by a substantially elliptically shaped orifice.

For a better understanding of the present invention, and to show how the same may be carried out in practice, reference will now be made to the accompanying drawings, in which

Fig. 1 is a longitudinally sectioned view of one form of rotary sprinkler in accordance with the present invention, illustrating the rotational and translational movement of a drive ball;

Fig. 2 is the same view of the rotary sprinkler with the drive ball shown when impacting an impeller element;

Fig. 3 is a longitudinally sectioned view of a rotary nozzle of the rotary sprinkler shown in Figs. 1 and 2; and

Fig. 4 is a plan view from below of the rotary nozzle shown in Fig. 3.

As seen in Figs. 1 and 2 of the drawings, the rotary sprinkler comprises a sprinkler housing 1 consisting of an upper housing component 1a screw coupled to a lower housing component 1b. The lower component 1b is formed with a water inlet 1c of the housing 1. Rotatably located within a water outlet 1d of the housing component 1a is an elongated outlet nozzle 2 whose construction will be described in detail with reference to Figs. 3 and 4 of the drawings. The lowermost portion of the

outlet nozzle 2 located within the housing 1 is formed integrally with a downwardly directed impeller element 3.

A cup-shaped drive motor enclosure 4 is located within the housing 1 and comprises a substantially planar base wall 5 and an outwardly tapering side wall 6. The base wall 5 is formed with a pair of tangentially directed water inlet apertures 7. The outwardly tapering side wall 6 comprises a first major axial portion 6a extending from the base wall 5 to an intermediate peripheral portion 8 thereof so as to define an angle α_1 with respect to a normal to the base wall 5 and a successive second minor axial portion 6b which extends from the intermediate peripheral position 8 to an edge rim 9 of the housing and so as to define a second angle α_2 with respect to the normal to the base wall. As can be seen, α_2 is substantially greater than α_1 . The housing is formed with an outwardly directed peripheral flange 10 which extends outwardly from the rim 9, the flange 10 being sandwiched between the screw-coupled-together housing portions 6a and 6b, thereby securely mounting in position the enclosure 6 within the housing 1.

As can be seen, the lowermost tip of the impeller element 3 is spaced from the peripheral position 8 by a distance X and from the base wall 5 by a distance Y .

A steel drive ball 11 is located within the housing 6 and is of a diameter D such that the distance Y is not substantially less than $2D$, whilst the distance X is not substantially less than $0.5D$.

If now water flows into the sprinkler housing 1 via the housing inlet 1c and into the enclosure 6 via the tangentially disposed water inlets 7, the drive ball 11 will have imparted to it a rotational motion and, at the same time, an upwardly directed displacement and will therefore effectively undergo an upwardly directed helical displacement as shown by the arrow 12 in Fig. 1. This displacement continues until the ball 11 reaches the intermediate peripheral position 8 (where it is still significantly displaced from the lower tip of the impeller element 3) and, at this stage, the continued displacement of the drive ball 11 results in a very rapid movement of the ball over the minor axial portion 6b until it is disposed well above the lower tip of the impeller element 3, which it then impacts at a relatively substantial peripheral position thereof. This impact of the ball and the impeller element results in the transfer to the impeller element of the ball's momentum, causing the instantaneous rotational displacement of the impeller element and its associated nozzle 2. The ball thereupon falls downwardly under gravity towards the base wall 5 of the enclosure 6 and, thereafter, starts again on its rotational and translational movement upwardly towards the impeller element 3.

Thus, with the rotary sprinkler and particularly with the drive motor thereof as described and illustrated, the rotary displacement of the drive nozzle is intermittent with relatively significant intervals between each displacement, the magnitude of each interval being determined by the time it takes for the drive ball to be rotatably displaced from its initial position in contact with the base wall 5 of the enclosure 4 into its impacting position with the impeller element 3.

In one embodiment of the present invention,

$D = 8 \text{ mm.}$

$X = 6 \text{ mm.}$

$Y = 20 \text{ mm.}$

$4^\circ \leq \alpha_1 \leq 7^\circ$ (preferably $\alpha_1 = 5^\circ$)

$40^\circ \leq \alpha_2 \leq 60^\circ$ (preferably $\alpha_2 = 45^\circ$)

Furthermore, the lateral spacing between the tip of the impeller element and the centre of the base wall was not substantially less than $1.75D$ (i.e. 14 mm.).

With such a rotary sprinkler, it is found that the range of sprinkling is considerably extended, as compared with a rotary sprinkler wherein the drive ball effectively rotates the nozzle substantially continuously.

Whilst the embodiment just described has involved the use of an enclosure with a smooth outwardly tapering side wall 6, the invention is equally applicable to a situation where this outwardly tapering side wall is helically grooved, thereby providing a helically grooved wall race.

It is to be pointed out that, by virtue of the use of the present invention wherein the side wall 6, which defines a relatively small first angle α_1 with the normal to the base wall 5, terminates in a second minor axial portion 6b which defines a much larger angle α_2 with respect to this normal, it is possible to achieve an enclosure structure which is very much more axially compact as compared with the prior art structures wherein the outwardly tapering side wall extends towards the region of the impeller element at a relatively uniform angle.

Reference will now be made to Figs. 3 and 4 of the drawings for a description of the outlet nozzle 2 shown in Fig. 1. As seen in the drawings, the outlet nozzle 2 comprises a tubular element 15 having a central, downwardly extending centring pin 16, the lowermost tip thereof is adapted to fit into a corresponding recess formed in a centrally directed supporting pin 17 which extends upwardly and integrally from the base wall 5 of the enclosure 4. Formed within the tubular element 15 is an axially directed tubular throughflow passage 17 and an outlet chamber 18 having an upper curved deflecting wall 19. The throughflow passage 17 communicates with the outlet chamber 18 via a substantially elliptically-shaped outlet 19.

It has been found that, by virtue of the provision of the elliptically-shaped outlet 19, a more effective outlet spray of significant range can be achieved.

Claims

1. A rotary sprinkler comprising a sprinkler housing (1); a water inlet (1c) of said housing; an outlet nozzle (2) of said housing (1) rotatably mounted with respect thereto; an open ended drive motor enclosure (4) fixedly located within said housing (1); a base wall (5) of said enclosure (4); an axially directed side wall (6) of said enclosure (4) which tapers outwardly with respect to said base wall (5); at least one tangentially directed opening (7) formed in said base wall (5) and communicating with said water inlet (1c); a drive ball (11) of predetermined diameter D located in said enclosure (4); an impact element (3) formed integrally with said nozzle (2) and spaced from said base wall (5) by a distance which is not substantially less than $2D$;

characterised in that

a first major axial portion (6a) of said side wall (6) extending from said base wall (5) to an intermediate peripheral position (8) thereof defines a first angle α_1 with respect to a normal to the said base wall (5) whilst a second minor axial portion (6b) of said side wall (6), extending from said intermediate peripheral position (8) to an edge rim (9) of the enclosure (4), defines a second angle α_2 with respect to a normal to the base wall (5) wherein α_2 is substantially greater than α_1 , said impact element (3) being spaced from said intermediate peripheral position (8) by a distance which is not substantially less than $0.5D$.

2. A rotary sprinkler according to Claim 1, characterised in that $1^\circ \leq \alpha_1 \leq 15^\circ$ whilst $45^\circ \leq \alpha_2 \leq 60^\circ$.
3. A rotary sprinkler according to Claim 1, characterised in that $4^\circ \leq \alpha_1 \leq 5^\circ$ whilst $40^\circ \leq \alpha_2 \leq 50^\circ$.
4. A rotary sprinkler according to claim 1, 2 or 3, wherein the outlet nozzle (2) of the housing (1) has defined therein an axially directed tubular throughflow passage (17) and an outlet chamber (18) communicating therewith formed with a curved deflecting wall (19), wherein the passage (17) communicates with the outlet chamber (18) via a substantially elliptically-shaped orifice (19).

Patentansprüche

1. Rotierender Sprinkler, umfassend ein Sprinklergehäuse (1); einen Gehäuse-Wassereinlaß (1c); eine Gehäuse-Auslaßdüse (2), die zum Gehäuse drehbar drehbar montiert ist; eine am Ende offene Antriebsmotorumwandung (4), die im Gehäuse (1) fest angeordnet ist; eine Umwandungs-Bodenwand (5); eine axial gerichtete Umwandungs-Seitenwand (6), die zur Bodenwand (5) konisch axial nach außen läuft; mindestens eine tangential gerichtete Öffnung (7), die in der Bodenwand (5) ausgebildet ist und mit dem Wassereinlaß (1c) verbunden ist; einen in der Umwandung (4) untergebrachten Antriebsball (11) mit vorbestimmtem Durchmesser D; ein Prallbauteil (3), das mit der Düse einstückig ausgebildet ist und mit einem Abstand, der nicht wesentlich kleiner als 2D ist, von der Bodenwand (5) beabstandet ist; dadurch gekennzeichnet,
daß ein erster Hauptachsenabschnitt (6a) der Seitenwand (6), die von der Bodenwand (5) zu einer zwischenliegenden Stelle (8) im Umfang verläuft, einen ersten Winkel α_1 zu einer Senkrechten zur Bodenwand (5) bestimmt, ein zweiter Nebenachsenabschnitt (6b) der Seitenwand (6) jedoch, der von der zwischenliegenden Stelle (8) im Umfang zu einer Wulstkante (9) der Umwandung (4) verläuft, einen zweiten Winkel α_2 zu einer Senkrechten zur Bodenwand (5) bestimmt, wobei α_2 wesentlich größer ist als α_1 und das Prallteil (3) von der Umfangszwischenstelle (8) um einen Abstand, nicht wesentlich kürzer als 0,5D, beabstandet ist.
2. Rotierender Sprinkler nach Anspruch 1, dadurch gekennzeichnet, daß für α_1 gilt $1^\circ \leq \alpha_1 \leq 15^\circ$ und für α_2 gilt $45^\circ \leq \alpha_2 \leq 60^\circ$.
3. Rotierender Sprinkler nach Anspruch 1, dadurch gekennzeichnet, daß für α_1 gilt $4^\circ \leq \alpha_1 \leq 5^\circ$ und für α_2 gilt $40^\circ \leq \alpha_2 \leq 50^\circ$.
4. Rotierender Sprinkler nach Anspruch 1, 2 oder 3, wobei die Gehäuse-Auslaßdüse (2) einen Durchlaß (17) bestimmt, der axial ausgerichtet und röhrenförmig ist, und eine damit verbundene Auslaßkammer (18), die mit einer gekrümmten Ablenk wand (19) ausgebildet ist, wobei der Durchlaß (17) über eine im wesentlichen ellipische Öffnung (19) mit der Auslaßkammer (18) verbunden ist.

Revendications

1. Arroseur rotatif, comprenant un boîtier d'arroseur (1); une entrée d'eau (1c) dudit boîtier; une buse de sortie (2) dudit boîtier (1), monté tournante par rapport audit boîtier; une enceinte de moteur d'entraînement (4), finissant en partie haute et montée fixe à l'intérieur dudit boîtier (1); une paroi de base (5) de ladite enceinte (4); une paroi latérale (6), orientée axialement, de ladite enceinte (4) présentant une conicité orientée en direction de l'extérieur, en s'éloignant de ladite paroi de base (5); au moins une ouverture (7) orientée tangentiellement étant formée dans ladite paroi latérale (5) et communiquant avec ladite entrée d'eau (1c); une bille d'entraînement (11), de diamètre prédéterminé D, évoluant dans ladite enceinte (4); un élément d'impact (3), formé d'un seul tenant avec ladite buse (2) et espacé de ladite paroi de base (5), d'une distance non sensiblement inférieure à 2D;
caractérisé en ce qu'
une première partie axiale principale (6a) de ladite paroi latérale (6) s'étendant depuis ladite paroi de base (5), jusqu'à une position périphérique (8) intermédiaire de celle-ci, définissant un premier angle α_1 par rapport à la normale à ladite paroi de base (5), tandis qu'une deuxième partie axiale secondaire (6b) de ladite paroi latérale (6), s'étendant depuis ladite position périphérique (8) intermédiaire jusqu'à une nervure de bordure (9) de l'enceinte (4), définissant un deuxième angle α_2 par rapport à la normale de la paroi de base (5), dans lequel α_2 est sensiblement supérieur à α_1 , ledit élément d'impact (3) étant espacé de ladite position périphérique intermédiaire (8) d'une distance non sensiblement inférieure à 0,5 D.
2. Arroseur rotatif selon la revendication 1, caractérisé en ce que $1^\circ \leq \alpha_1 \leq 15^\circ$, avec, simultanément, $45^\circ \leq \alpha_2 \leq 60^\circ$.
3. Arroseur rotatif selon la revendication 1, caractérisé en ce que $4^\circ \leq \alpha_1 \leq 5^\circ$, avec, simultanément, $40^\circ \leq \alpha_2 \leq 50^\circ$.
4. Arroseur rotatif selon la revendication 1, 2 ou 3, dans lequel, à l'intérieur de la buse de sortie (2) du boîtier (1), sont définis un passage traversant tubulaire (17) orienté axialement et une chambre de sortie (18), communiquant avec celui-ci et ménagée avec une paroi déflectrice (19) incurvée, dans lequel le passage (17) communique avec la chambre de sortie (18), par l'intermédiaire d'un orifice (19) à forme

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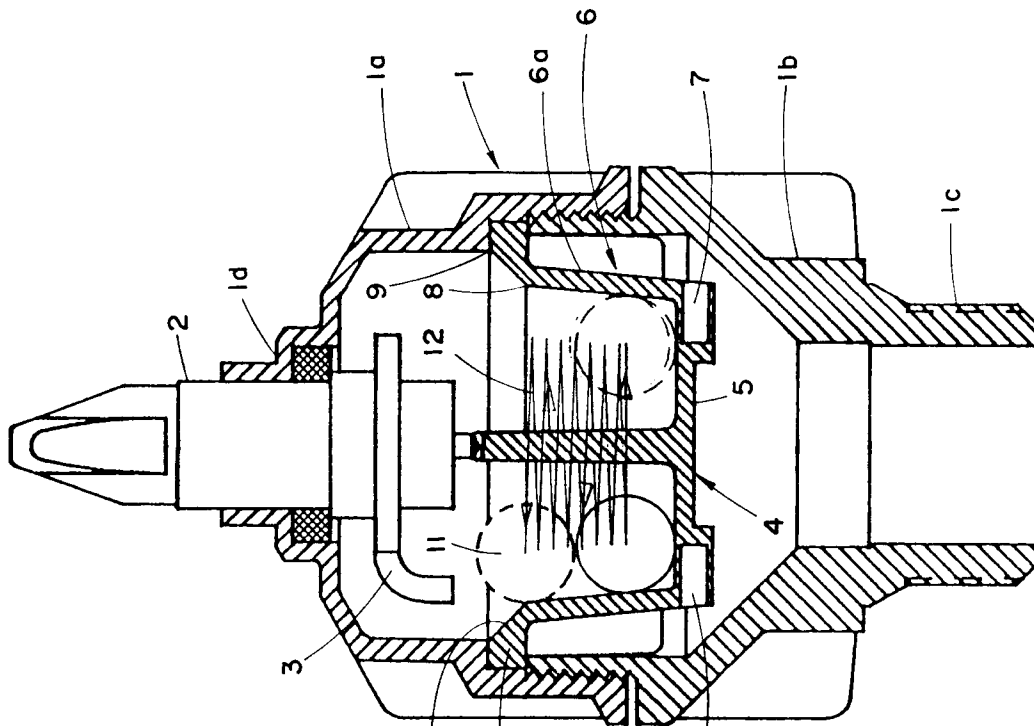


Fig. 1

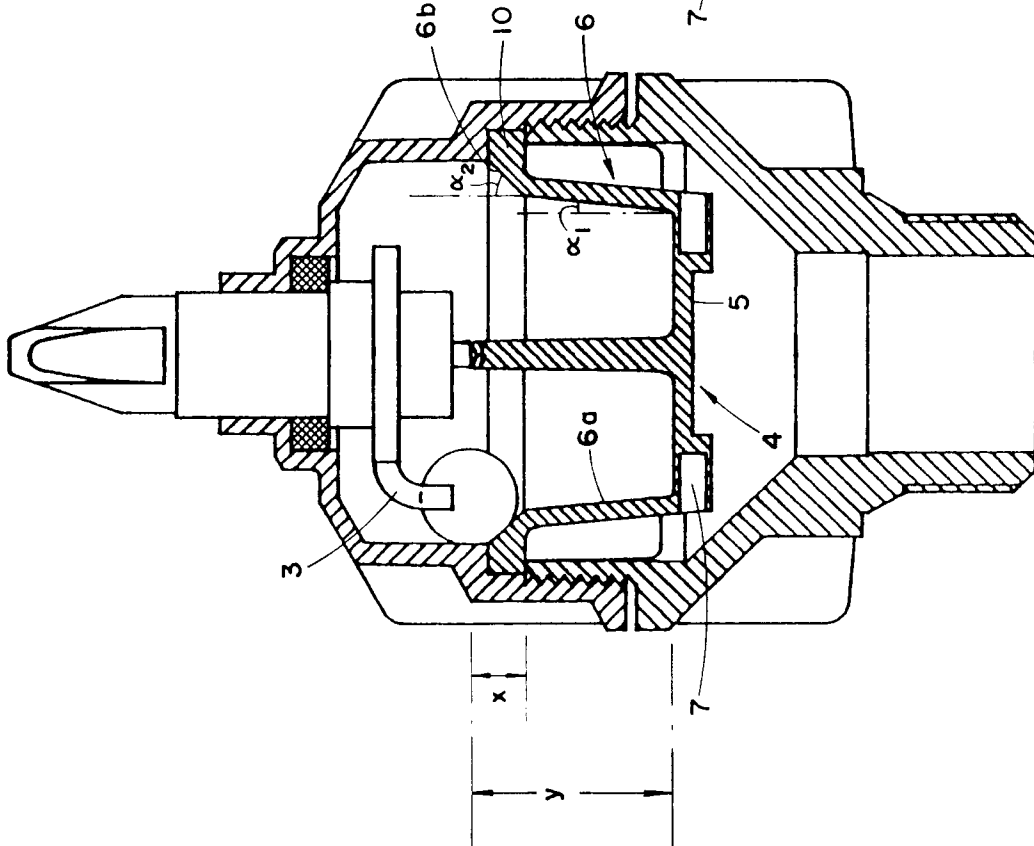


Fig. 2

Fig. 4

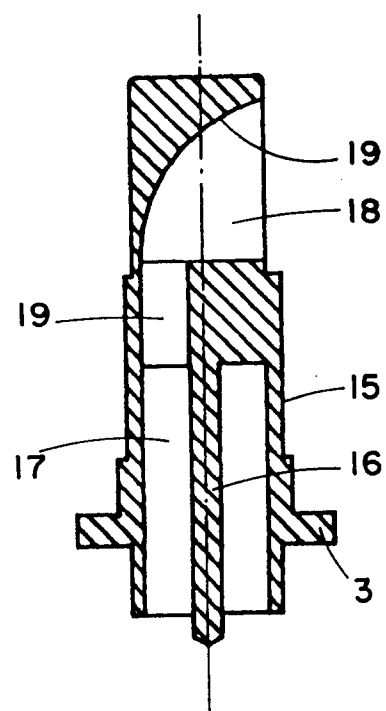
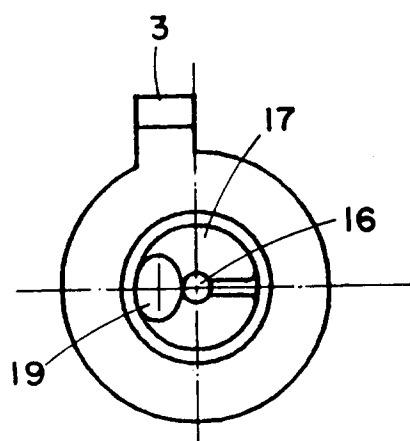


Fig. 3